

WHAT IS CLAIMED IS:

1. A touchframe system for determining the position of a touch event within a display area, said system comprising:
 - a plurality of light emitting elements positioned around the perimeter of the display
 - 5 area;
 - a plurality of light receiving elements, each of the light receiving elements in combination with a plurality of the light emitting elements forming a zone of light beam paths, the number and positioning of receivers being sufficient to form partially overlapping zone pairs such that the touch event lies within at least two partially overlapping zone pairs; and
 - 10 a processor programmed to:
 - monitor each of the zone pairs for blockage of at least one light beam path; and
 - upon such blockage, calculate the location of the touch event associated with the blockage based on the slopes and end points of at least two intersecting blocked light beam paths from a first zone pair and two
 - 15 intersecting blocked light beam paths from a second zone pair.
2. The system of claim 1 wherein the processor monitors each of the zone pairs for blockage by being programmed to:
 - randomly activate the light emitting elements, one at a time; and
 - monitor the output of each light receiving element associated with the activated light
 - 5 emitting element for an output indicative of a blocked light beam path.
3. The system of claim 2 wherein the processor is further programmed to activate the light emitting elements at pseudo random intervals.
4. The system of claim 2 wherein the processor is further programmed to activate the light emitting elements in a pseudo random sequence.
5. The system of claim 2 wherein the light receiving element outputs a signal having a pulse edge upon receipt of light and the processor is programmed to tag a light beam as blocked in the absence of a pulse edge in the light receiving element output.

6. The system of claim 1 wherein the processor is programmed to selected the first and second zone pairs based on the angles formed by the intersecting light beam paths.

7. The system of claim 6 wherein the processor is further programmed to select those zones pairs having the most orthogonal angles.

8. The system of claim 1 wherein the processor is programmed such that, when the touch event blocks an odd plurality of light beam paths within a zone, touch event location calculation is done using the center blocked light beam path.

9. The system of claim 1 wherein the processor is programmed such that, when the touch event blocks an even plurality of light beam paths within a zone, touch event location calculation is done using a virtual beam located between the two central blocked light beam paths.

10. A method of determining the location of a touch event within a display area surrounded by a touch frame having a plurality of light emitting elements and a plurality of light receiving elements forming a plurality of zones of light beam paths, the number and positioning of receivers being sufficient to form partially overlapping zone pairs such that the touch event lies within at least two zone pairs, said method comprising:
monitoring each of the zone pairs for blockage of at least one light beam path; and
upon such blockage, calculating the location of the touch event associated with the blockage based on the slopes and end points of at least two intersecting blocked light beam paths from a first zone pair and two intersecting blocked light beam paths from a second zone pair.

11. The method of claim 10 wherein monitoring each of the zone pairs for blockage of at least one light beam path comprises:

randomly activating the light emitting elements, one at a time; and
monitoring the output of each light receiving element associated with the activated light emitting element for an output indicative of a blocked light beam path.

12. The system of claim 11 wherein the light emitting elements are activated at pseudo random intervals.

13. The system of claim 11 wherein the light emitting elements are activated in a pseudo random sequence.

14. A touchframe system comprising:

a plurality of opposed perimeter sections;

a plurality of triangular zones, each including a row of light emitting elements positioned along one of the perimeter sections and an associated light receiving element positioned along the perimeter section opposite the light emitting elements, each of the light emitting elements and associated light receiving element defining a light beam path;

a memory device having stored therein the slopes and end points of each light beam path within each of the plurality of triangular zones; and

a processor programmed to:

randomly activate the light emitting elements, one at a time;
monitor the output of each light receiving element associated with the activated light emitting element for blockage of a light beam path; and
upon such blockage, calculate the location of the source of blockage based on the slopes and end points of at least two intersecting blocked light-beam paths.

15. The system of claim 14 wherein each row of light emitting elements has two associated light receiving elements positioned such that the two triangular zones formed by the light emitting elements partially overlap.

16. The system of claim 15 wherein the light receiving elements have an associated acceptance angle and the light emitting elements have an associated angle of light dispersion and the elements are arranged relative each other such that the center of the acceptance angle of each receivers is directed toward the center of the row of light emitting elements and the center of the angle of dispersion of each light emitting element is directed toward a point midway between the two receivers.

17. The system of claim 14 wherein the location of the light receiving element defines the end points of the light beam paths.

18. The system of claim 14 wherein the processor is further programmed to activate the light emitting elements at pseudo random intervals.

19. The system of claim 14 wherein the processor is further programmed to activate the light emitting elements in a pseudo random sequence.

20. The system of claim 14 wherein the processor is programmed to inspect at least one orthogonal pair of triangular zones associated with the source of blockage for the two intersecting light beam paths.

21. The system of claim 14 wherein the processor monitors the output of each light receiving element associated with the activated light emitting element for blockage of a light beam path by being programmed to:

- 5 compare the profile of the output to an expected profile having a time-based noise threshold;
- identify a light beam as noise if there is a pulse edge in the profile prior to the noise threshold;
- identify a light beam as connected if there is a pulse edge in the profile after the noise threshold; and
- 10 identify all other light beams as blocked.

22. The system of claim 21 wherein the time-based noise threshold is defined by the response time of the light receiving element.

23. The system of claim 21 wherein the processor comprises a state counter for counting the identification of a light beam over successive triggers of the light emitting element associated with the light beam and outputting a confirmed blocked or connect identification after the counter has reached a specified value.

24. The system of claim 23 wherein the specified value is at least two successive triggers of the associated light emitting element.

25. A method of determining the location of a touch event within a display area surrounded by a touch frame having a plurality of light emitting elements and a plurality of light receiving elements forming a plurality of triangular zones of light beam paths each having a slope and endpoints, the number and positioning of receivers being sufficient to form
5 partially overlapping zone pairs, said method comprising:

for each of the plurality of triangular zones, storing the slopes and end points of each light beam path;

randomly activating the light emitting elements, one at a time;

monitoring the output of each light receiving element associated with the activated
10 light emitting element for blockage of a light beam path; and

upon such blockage, calculating the location of the source of blockage based on the slopes and end points of at least two intersecting blocked light-beam paths.

26. The method of claim 25 wherein monitoring the output of each light receiving element associated with the activated light emitting element for blockage of a light beam path comprises:

comparing the profile of the output to an expected profile having a time-based noise
5 threshold;

identifying a light beam as noise if there is a pulse edge in the profile prior to the noise threshold;

identifying a light beam as connected if there is a pulse edge in the profile after the noise threshold; and

10 identifying all other light beams as blocked.

27. The method of claim 26 wherein the time-based noise threshold is defined by the response time of the light receiving element.

28. The method of claim 26 wherein identifying a light beam as connected or blocked comprises:

counting the identification of a light beam over successive triggers of the light emitting element associated with the light beam; and

5 outputting a confirmed blocked or connect identification after the counter has reached a specified value.

29. The method of claim 28 wherein the specified value is at least two successive triggers of the associated light emitting element.

30. A touchframe system for determining the position of a touch event within a display area, said system comprising:

 a plurality of light emitting elements positioned around the perimeter of the display area;

5 a plurality of light receiving elements, each of the light receiving elements in combination with a plurality of the light emitting elements forming a zone of light beam paths, the number and positioning of receivers being sufficient to form partially overlapping zone pairs such that the touch event lies within at least one partially overlapping zone pair; and

 a processor programmed to:

10 randomly activate the light emitting elements, one at a time;
 monitor the output of each light receiving element associated with the
 activated light emitting element for blockage of a light beam path; and
 upon such blockage, calculate the location of the touch event associated with
 the blockage based on the slopes and end points of at least two
15 intersecting blocked light-beam paths.

31. The system of claim 30 further comprising a memory device having stored therein the slopes and end points of each light beam path within each of the zones

32. The system of claim 30 wherein:

 the number and positioning of receivers is sufficient to form redundant overlapping zone pairs such that the touch event lies within at least two partially overlapping zone pairs;
 and

5 the processor is programmed to calculate the location of the touch event based on the

slopes and end point of a pair of intersecting blocked light-beam paths from each of the at least two partially overlapping zone pairs.

33. The system of claim 32 wherein the processor is programmed to calculate the location of the touch event using the most orthogonally overlapping zone pairs.

34. The system of claim 32 wherein the processor is programmed to:
individually calculate a location of the touch event for each pair of intersecting blocked light-beam paths; and
average the individual results to obtain the location of the touch event.

35. The system of claim 32 wherein the zones are triangular with a row of light emitting elements forming one side of the triangle and one light receiving element forming an apex opposite the row of light emitting elements.